AIR RESOURCES BOARD
EQUIPMENT AND PROCESS PRECERTIFICATION EVALUATION
(CONVERSION OF PROVISIONAL EQUIPMENT PRECERTIFICATION)
July 1, 1998

Applicant: **Fulton Boiler Works, Incorporated**
3981 Port Street, Box 257
Pulaski, New York 13142-0257

Application No.: 96009
Executive Order: G-96-029-005-A

Model Numbers: **ICS 50-LE; ICW 50-LE; ICX 50-LE; FB-050-A-LE; FB-50-F-LE**

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GENERAL INFORMATION:

1. Program Background and Applicant Request

The Air Resources Board's (ARB's) Equipment and Process Precertification Program (Program) is a voluntary statewide program for manufacturers of commonly-used equipment that emit air pollutants. This Program is designed to assist local air pollution control and air quality management districts (Districts) in their efforts to streamline the air pollution permit process. On June 14, 1996, the Air Resources Board (ARB) adopted section 91400 of the California Code of Regulations which incorporates the Criteria for Equipment and Process Precertification (Criteria). The regulation and Criteria were approved by the California Office of Administrative Law on October 31, 1996 and became effective on November 30, 1996. Prior to the regulatory approval, the ARB staff conducted a pilot precertification program. All equipment provisionally precertified under the pilot program was given the option to convert the provisional precertification upon the payment of fees.

This evaluation is designed to verify performance claims made by manufacturers with regard to specific equipment models. Performance claims are made by the applicants in the Scope of the Precertification as part of the application package. All manufacturer claims must be supported through verification testing and validated by ARB staff review.

Fulton Boiler Works, Incorporated (Fulton) requested conversion of the provisional precertification issued under the ARB Equipment and Process Precertification Pilot Program for the **Fulton 50 horsepower** natural gas steam boiler (model numbers **ICS 50-LE; ICW 50-LE; ICX 50-LE; FB-050-A-LE; and FB-50-F-LE**.)

2. Equipment / Process Description:

Type of Equipment:	natural gas fired steam boiler
Description Process:	high and low pressure process steam and hot water boilers
Fuel:	Public Utility Commission (PUC) quality natural gas
Boiler Heat Output:	**50 horsepower (BHP)**
Model Numbers:	**ICS 50-LE; ICW 50-LE; ICX 50-LE; FB-050-A-LE; and FB-50-F-LE**
Heat Input:	**2,100,000 British Thermal Units per hour (BTU/hr)**

3. Air Pollution Control Equipment:

The **Fulton 50 BHP** steam boiler (model numbers **ICS 50-LE; ICW 50-LE; ICX 50-LE; FB-050-A-LE; and FB-50-F-LE**) consists of a burner that utilizes a premix design which combines fuel and air prior to the ignition point. The premix gas then flows at an increased velocity which decreases the residence time of reactants within the flame zone, which reduces the emissions.

SUMMARY OF THE SCOPE:

The applicant seeks precertification for the **Fulton 50 BHP** steam boiler (model numbers **ICS 50-LE; ICW 50-LE; ICX 50-LE; FB-050-A-LE; and FB-50-F-LE**) for the following standards:

1. Oxides of nitrogen (NO_x) less than 25 parts per million by volume measured on a dry basis (ppmdv), corrected to 3 percent oxygen (O_2)
2. NO_x less than 20 nanograms per Joule (ng/J) or .05 pounds per million British thermal units (lb/ MM BTU)
3. Carbon Monoxide (CO) less than 50 ppmdv, corrected to 3 percent O_2

APPLICABLE STATE AND FEDERAL REQUIREMENTS:

There are no applicable State and federal air pollution regulations for boilers of this size.

EMISSIONS:

The emission estimate for NO_x is based on using the precertification concentration value of 25 ppmdv, corrected to 3 percent O_2 as a limit. This assumes that all NO_x formed is in the form of NO_2. Similarly, the emission estimate for CO is based on using the precertification concentration value of 50 ppmdv, corrected to 3 percent O_2 as a limit. Both NO_x and CO are pollutants verified for this precertification under the ARB Equipment and Process Precertification

Program.

Pollutant	Emission Factor	Potential to Emit
NO_2	30.3 lb/MM dscf	**6.36 E-2** lb NO_x/hr
CO	36.9 lb/MM dscf	**7.75 E-2** lb CO/hr

Emissions for the other criteria pollutants- sulfur dioxide (SO_2), volatile organic compounds (VOC) and particulate matter (PM), have been estimated using United States Environmental Protection Agency (U.S. EPA) AP-42 Section 1.4 for Commercial Boilers (.3-<10 MM BTU) Controlled- Low NOx Burner (Revised January 1995) and the maximum heat input of **2,100,000 BTU/hr**. These emissions have not been verified by emissions testing, but are provided for informational purposes for Districts.

Pollutant	Emission Factor	Potential to Emit
SO_2	.6 lb/MM dscf	**1.26 E-03 lb/hr**
VOC	5.28 lb/MM dscf	**1.11 E-02 lb/hr**
PM	12 lb/MM dscf	**2.52 E-02 lb/hr**

Emissions of formaldehyde (HCHO) have been estimated using U.S. EPA- 450 / 2-90-011, Toxic Air Pollutant Emission Factors - A Compilation for Selected Air Toxic Compounds and Sources, Second Edition (October 1990) for commercial natural gas combustion. These emissions have not been verified by emissions testing, but are provided for informational purposes for Districts.

Pollutant	Emission Factor	Potential to Emit
HCHO	.2203 lb/MM dscf	**4.63 E-04 lb/hr**

EVALUATION OF TEST REPORT:

Verification testing was conducted by an independent testing laboratory, the Center for Emissions Research and Analysis (CE-CERT) located in California. The **Fulton 50 BHP** steam boiler that was tested has the same configuration as the models for which Fulton is seeking certification. This unit was tested with the high velocity /excess air premix low NO_x burner installed. This corresponds with the production models for which precertification was requested. Verification that the boilers tested were equipped with the low-emission burners was supplied by

both a letter from CE-CERT and Fulton.

The testing protocol was followed in accordance with South Coast Air Quality Management District (SCAQMD) Rule 1146.1: Emissions of Oxides of Nitrogen from Small Industrial, Institutional, and Commercial Boilers, Steam Generators, and Process Heaters (revised 5/13/94) using SCAQMD Method 100.1. Currently, the SCAQMD method is more stringent than ARB method 100. The SCAQMD method specifies certain performance requirements that discriminate against faulty data. The SCAQMD method also includes procedures which assist to better ensure there are no leaks in the system. Recently, ARB method 100 was revised to align more closely with the SCAQMD method.

The test report evaluation was conducted by staff of ARB's Monitoring and Laboratory Division. It was their recommendation along with the staff of the Stationary Source Division, Project Support Section that the **Fulton 50 BHP** steam boiler (model numbers **ICS 50-LE; ICW 50-LE; ICX 50-LE; FB-050-A-LE; and FB-50-F-LE**) be precertified as meeting the standard of less than 25 ppmdv of NOx, 50 ppmdv of CO, both pollutants corrected to 3 percent oxygen. The air-fuel ratio is fixed for each boiler. The **Fulton 50 BHP** steam boiler (model numbers **ICS 50-LE; ICW 50-LE; ICX 50-LE; FB-050-A-LE; and FB-50-F-LE**) is also precertified as meeting the NO_x standard of less than .05 lb/MM BTU (20 ng/J).

CONCLUSIONS:

The test data, scope, and application were submitted by Fulton for precertification consideration. The test data were reviewed by staff of the Monitoring Laboratory Division of the ARB, and found to meet the data quality objectives outlined in the scope for NO_x and CO. The ARB has reviewed this information along with applicable State and federal air pollution rules and concludes that this boiler is generally exempt from current State and federal rules. However, local District rules may be applicable in some regions. The applicable local Districts were forwarded a copy of the precertification evaluation for review and comments.

RECOMMENDATIONS:

The Center for Emissions Research and Analysis test data was found to support the claims made by Fulton regarding the **Fulton 50 BHP** steam boiler (model numbers **ICS 50-LE; ICW 50-LE; ICX 50-LE; FB-050-A-LE; and FB-50-F-LE**). The test data verified that the boiler would meet 25 ppmdv NOx, 50 ppmdv of CO, both corrected to 3 percent O_2. Therefore, the ARB staff recommends precertification under the Equipment Precertification Pilot Program of the **Fulton 50 BHP** steam boiler (model numbers **ICS 50-LE; ICW 50-LE; ICX 50-LE; FB-050-A-LE; and FB-50-F-LE**) to the levels stated above.

PRECERTIFICATION CONDITIONS:

1. Precertification does not relieve the person constructing, installing or operating the equipment at each specific site from the requirement to obtain an authority to construct and permit to operate. Precertification does not relieve a person from compliance with any local air rule or regulation.
2. Any manufacturer's modification that affects the performance or emissions of this boiler shall void this precertification. This precertification is valid only for the equipment designed and tested for this evaluation.

RECOMMENDED OPERATING CONDITIONS:

1. This equipment shall be properly operated and maintained in accordance with manufacturer's recommended operating and maintenance instructions. This equipment shall be properly maintained and kept in good operating condition at all times. This includes cleaning the burner assembly every six months and keeping the equipment in good operating conditions at all times.

2. This boiler shall be fired with PUC quality natural gas only.

APPENDIX A

CALCULATIONS

1. ESTIMATED EMISSIONS FOR PRECERTIFIED POLLUTANTS:

Precertification standards for NO_2 and CO have been identified in the scope of the precertification. The emission factor in pounds (lbs) per MMBTU was determined using the threshold value of 25 ppmdv of NO_2, and 50 ppmdv of CO, both corrected to 3 percent oxygen (% O_2), as specified in the scope by the applicant.

This emission factor was determined using 40 CFR Method 19- Section 2.1. The emission rate can be determined from:

$$E = C_d F_d [20.9 / (20.9 - \%O_{2d})]$$

E= emission rate (lb/ MM dscf)
C_d= concentration in lb/ dry standard cubic feet (dscf)
F_d= F Factor for natural gas = 8710 dscf /MM BTU
O_{2d}= 3 (since concentration is corrected to 3%)

First, convert the concentration

$$C_d = C_{mf} XM$$

C_d= concentration in lb/dscf
C_{mf}= mole fraction
X= molecular weight
M= conversion factor of 1 lb mole of combustion gas to dscf at an absolute pressure of 14.7 psia and a temperature of 68 F.
= 1 lb mole / 385.4 dscf

Using the above equation the NO_2 emission estimate is:

C_d = (25 E-06) (46 lb NO_2 / 1 lb mole NO_2) (1 lb mole / 385.4 dscf)
C_d = 2.98 E-6 lb/dscf

Then substituting values into the emission rate equation:

E= (2.98 E-6 lb/dscf) (8710 dscf / MM BTU) (20.9 / 17.9) (1000 BTU / dscf)
E= 30.3 lb NO_2 / MM dscf

The NO_2 emissions per hour can be determined using the maximum heat input of the unit = **2,100,000 BTU/hr** [For natural gas 1 dscf = 1000 BTU]. The potential to emit was determined using:

PE = EH

PE = estimated potential to emit
E= emission factor
H= heat input

PE_{NO2} = (30.3 lb NO_2 /MMdscf) (1 dscf /1000 BTU) (**2,100,000** BTU /hr)
= **6.36 E-2** lb NO_2 /hr

Similarly, CO emission calculations:

C_d = (50 E-06) (28 lb CO / 1 lb mole CO) (1 lb mole / 385.4 dscf)
C_d = 3.63 E-6 lb/dscf

Then substituting values into the emission rate equation:

E= (3.63 E-6 lb/dscf) (8710 dscf / MM BTU) (20.9 / 17.9) (1000 BTU / dscf)
E= 36.9 lb CO / MM dscf

PE_{CO} = (36.9 lb CO /MMdscf) (1 dscf / 1000 BTU) (**2,100,000** BTU/hr)
= **7.75 E-2** lb CO/hr

2. ESTIMATED EMISSIONS FOR THE OTHER CRITERIA POLLUTANTS:

For the other pollutants, emissions were estimated using AP-42 Section 1.4 emission factors and the potential to emit equation above. The maximum heat input of the unit = **2,100,000 BTU/hr** [For natural gas 1 dscf = 1000 BTU]. The resulting emission estimates are:

SO_2 emission factor= .6 lb /MMdscf
SO_2 = (.6 lb/MMdscf) (1 dscf / 1000 BTU) (**2,100,000** BTU/hr) = **1.26 E-03** lb /hr

VOC emission factor= (1-.34)" 8.0 lb/MMdscf = 5.28 lb/MMdscf
VOC = (5.28 lb/MMdscf) (1 dscf / 1000 BTU) (**2,100,000** BTU/hr) = **1.11 E-02** lb /hr

PM(total) emission factor= PM (filterable) + PM (condensible)
= 4.5 lb/MMdscf + 7.5 lb/MMdscf = 12 lb /MM dscf
PM = (12 lb/MMdscf) (1 dscf / 1000 BTU) (**2,100,000** BTU/hr) = **2.52 E-02** lb /hr

" methane comprises 34 percent of the total organic compounds

3. ESTIMATED EMISSIONS OF FORMALDEHYDE:

For formaldehyde, emissions were estimated using EPA- 450 / 2-90-011, Toxic Air Pollutant Emission Factors - A Compilation for Selected Air Toxic Compounds and Sources, Second Edition (October 1990) for commercial natural gas combustion.

HCHO emission factor = 220.3 lb /10 E12 BTU
HCHO = (220.3 lb/ 10 E12 BTU) (**2,100,000** BTU/hr) **= 4.63 E-04** lb /hr

4. CORRECTION FROM MEASURED TEST DATA OF NO_X TO 3% OXYGEN:

$$[NO_x]_{@\ 3\%\ O2} = [NO_x]_{@\ actual\ \%O2}\ (21-3)/(21-actual\ \%O_2)$$

Test	O_2% estimated	NO_x ppmdv measured	NO_x ppmdv corr. to 3% O_2
1	5.9259	13.34803	15.94
2	5.985617	13.56186	16.26
3	5.957661	13.77553	16.48
		avg=	**16.22**

5. CORRECTION FROM MEASURED TEST DATA OF CO TO 3% OXYGEN:

$$[CO]_{@\ 3\%\ O2} = [CO]_{@\ actual\ \%O2}\ (21-3)/(21-actual\ \%O_2)$$

Test	O_2% estimated	CO ppmdv measured	CO ppmdv corr. to 3% O_2
1	5.9259	12.81043	15.30
2	5.985617	12.49912	14.98
3	5.967661	12.20539	14.61
		avg=	**14.96**

6. CONVERSION FROM CONCENTRATION MEASURED TO EMISSION RATE:

Again using the concentration equation C_d from section 1 of this Appendix, the mean concentration of NO_x can be converted to an emission rate in lbs/ MM BTU.

C_d = (16.22 E-06) (46 lb NO_2 / 1 lb mole NO_2) (1 lb mole / 385.4 dscf)
C_d = 1.94 E-6 lb/dscf

Then converting from dry standard cubic feet to MM BTU using the F factor for natural gas (where the dry combustion from natural gas combustion equals 8710 dscf/ MM BTU):

E= (1.94 E-6 lb/dscf) (8710 dscf / MM BTU)
E= 1.69 E-02 lb NO_2 / MM BTU

Then converting lbs to grams and BTU to joules the emission rate becomes:

E= (1.69 E-02 lb NO_2 / MM BTU) (BTU / 1055 J) (454 g / lb)
E = 7.27 ng / J